UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
166 Water Street
Woods Hole, MA 02543

20 March 2002

CRUISE RESULTS

NOAA Fisheries Research Vessel DELAWARE II
Cruise DE 01-09 (Parts I – IV)

Atlantic Herring Hydroacoustic Survey

CRUISE PERIOD AND AREA

The 2001 Fall Atlantic Herring Hydroacoustic Survey was conducted during four parts between 4 September and 12 October 2001. Scientific operations were conducted in the Gulf of Maine and Georges Bank regions, including the Canadian Exclusive Economic Zone on eastern Georges Bank.

OBJECTIVES

Cruise objectives were to (1) calibrate the transducers of the EK500 scientific echosounder, (2) conduct acoustic surveys of Atlantic herring (*Clupea harengus*) spawning stocks in the Gulf of Maine and Georges Bank regions to provide fisheries independent abundance estimates, (3) repeat the Georges Bank survey using varies survey designs, (4) collect *in-situ* multi-frequency target strength (TS) measurements on herring, and (5) test and evaluate advanced technologies (*e.g.*, broad-band acoustics) for improving fisheries acoustics estimates.

METHODS

EK500 Calibrations:

The multifrequency Simrad EK500 Scientific Sounder must be calibrated before each survey to ensure precise and accurate backscatter measurements required for species-specific population estimates. Standard sphere calibrations were conducted for each frequency before the survey to ensure that the system was operating properly with high accuracy and precision in the measurements. The FRV Delaware's EK500 operated three downward looking hull-mounted transducers (one 12 kHz single-beam transducer, and two split-beam transducers at 38 and 120 kHz). During the first day (4 September), the 38 and 120 kHz split-beam transducers were successfully calibrated alongside the pier of the Woods Hole Oceanographic Institute. For each frequency, a calibration sphere of known target strength was suspended under each transducer. The sphere was moved throughout the beam pattern using three remotely controlled downriggers. Gain and angle offset parameters for the 38 and 120 kHz transducers were derived using the Simrad Lobe (v.95-01-17) program. The TS and Sv gain for the 38 kHz was modified to 23.28 and 23.10 dB, respectively. The TS and Sv gain settings for the 120 kHz remained unchanged from the last survey (26.20 and 26.10 dB, respectively). The single-beam 12 kHz transducer was calibrated in the Gulf of Maine during 7 September, and its previous gain settings of 18.3 dB were not changed. Ambient noise tests were conducted to ensure there was no cross-interference between acoustic instrumentation. The amplitude from the EK500 test/transceiver menu was routinely checked during and at the end of the survey to ensure the EK500 system was working properly.

Hydroacoustic Survey Operations:

Atlantic Herring Hydroacoustic Surveys have been conducted by the Northeast Fisheries Science Center (NEFSC) during the autumns since 1998, in which standardized NEFSC hydroacoustic survey procedures have been implemented. Systematic surveys were conducted on selected historical spawning grounds of Atlantic herring in the Gulf of Maine and Georges Bank regions. Standardized NEFSC hydroacoustic operations included continuous EK500 and SCS data collection throughout the cruise track and during gear deployments. Midwater trawling, underwater video, and CTD deployments were routinely conducted to identify acoustic backscatter, and obtain biological and oceanographic data. Biological samples were collected and processed according to standard NEFSC procedures. EK500 acoustic data were routinely processed at sea using the Echoview post-processor. Continuous and deployment data were linked and managed using the SCS Event Logger program. During this year's survey, the northern Georges Bank region was surveyed several times using various survey designs to determine the optimum design to adopt for future NEFSC fisheries acoustic surveys.

EK500 Survey Operations:

The multifrequency Simrad EK500 (v.5.30) Scientific Sounder was the primary instrumentation used to obtain acoustic measurements for conversion to herring population estimates. The EK500 was operated continuously throughout the cruise during the systematic transects and gear deployments. Survey transects were defined as a course of constant heading and survey speed (ranging 8-11 knots), and were sequentially numbered throughout the cruise. All gear deployments were also sequentially numbered. After a deployment, the current transect number was assigned when resuming the same course heading and survey speed. EK500 data were collected simultaneously from three frequencies (12, 38, and 120 kHz) at a ping rate of 2 seconds throughout the cruise track. The EK500 echo-integrator vertically integrated volume backscatter (Sv in units of m^2/m^3) into 0.5 m depth increments. Data between the surface and the bubble layer were not included in the analysis to eliminate scattering by surface bubbles and noise. The bubble layer was set to 10 m for the 38 and 120 kHz data, 32 m for the 12 kHz data. Volume backscatter were converted to cross-sectional backscatter (Sa in units of m^2/nmi^2) as a relative index of abundance along the cruise track. Individual target strength (TS) measurements were also collected by the EK500, and are used to scale acoustic indices to abundance. EK500 data were logged with the Echoview software (release 2.20.5) via TCP/IP ETHERNET line. The EK500 received its navigational input from the vessel's Scientific Computer System (SCS) differential GPS output. Preliminary post-processing of the EK500 data was conducted at sea using Echoview. Post-processing included removal of unwanted noise and bottom backscatter, and partitioning of the herring acoustic backscatter.

High Speed Midwater Rope Trawl Sampling Operations:

The High Speed Midwater Rope Trawl (HSMRT, Gourock design R2028825A) was the primary sampling gear used to verify fish backscatter and collect biological data. The four seam HSMRT pelagic trawl was designed with 53.1 m headrope, footrope, and breastlines to provide a 350 m^2 net opening (averaging 13 ± 3 m vertical and 27 ± 5 m horizontal). The HSMRT was rigged to 1.8 m^2 double-foiled Suberkrub-type doors with 62.4 m of upper and lower bridles/legs. The optimum tow configuration (2.5 m setback, 272 kg tomweights, intermediate door spread with two shoe weights per door) was used during survey operations (refer to Cruise Results DE 98-09 for further details). The HSMRT was towed at 4-5 knots typically for 30 minutes in duration. However, tow duration often varied between 10 to 60 minutes depending on acoustic fish signals observed during the tow. Tow duration was defined as the time between setting the doors and when doors were hauled out of the water. The tow profile of the trawl was typically dropped incrementally through the water column to the desired depth of the scattering layer or when the footrope was about 10 m from the bottom, and held at the targeted backscatter layer for the duration depending on the fish targets observed passing into the trawl by the trawl monitoring system.

HSMRT deployments were targeted on selected fish backscatter along the cruise track, and generally conducted about once per 6 hour watch. Deployments served to verify species composition for partitioning of backscatter and obtaining biological catch data. Trawl duration, tow depths, and tow speeds were not standardized or consistent between trawls, therefore trawl catch data should not be used for abundance estimates.

Midwater Trawl Monitoring:

The HSMRT trawl tow profile and performance were monitored using a Simrad FS903 and ITI systems. The Simrad FS903 Trawl Monitoring System via third-wire constant tension winch provided real-time sonar images of the trawl opening and performance. The FS903 sonar display also showed acoustical signals of fish passing through or around the trawl opening, thus allowed the tow duration to be minimized for capturing only the necessary amount of herring required for scientific samples. The Simrad ITI wireless trawl sensors were used to obtain point measurements of the trawl depth, wing spread, and door spread. Vemco Minilog depth-temperature probes were attached to the trawl headrope and footrope to provide continuous depth-temperature and trawl performance profile data for each deployment.

Biological Sampling:

The catch from each trawl was sorted by species, weighed, and measured (fork length to the nearest cm) according to standard NEFSC procedures. Additional biological sampling for Atlantic herring included individual weights (to nearest 0.1 g), fork lengths (nearest mm), stomach content analyses, and otolith samples for aging.

Furuno CSH-5 Omni-directional Sonar:

A 64 kHz Furuno CSH-5 Omni-directional Sonar was used intermittently during survey for locating fish aggregations and documenting the horizontal spatial patterns of herring schools. The CSH-5 sonar simultaneously scanned a full 360^0 with a cone-shaped receiving beam, and its beam was usually angled $7\text{-}10^0$ from the surface to eliminate surface noise. The 10^0 tilt angle and 15^0 vertical width of the receiving beam generally resulted in a horizontal search radius of 800 m when bottom depths were around 200 m. In shallow waters of less than 80 m depth, the search radius of the cone-shaped beam was reduced to 250 m. The external trigger of the sonar was wired as a slave to the EK500 in order to synchronize its ping for eliminating acoustical interference. Analog images from the omni-directional sonar were obtained every 30 seconds using a video capture-board, and these files were merged with the SCS navigational data and archived.

Multi-purpose Underwater Video System:

The Multi-purpose Underwater Video System (MUVS) was configured for this cruise to directly verify and obtain stereo imagery of acoustic targets alongside the EK500 acoustical beam. The MUVS was deployed midship from the forward A-frame alongside the acoustic beam of the EK500 while the FRV Delaware drifted over selected backscatter aggregations. A pair of matched underwater low-light CCD video cameras (DSP&L Super SeaCam 5000) were mounted in the MUVS to obtain stereo imagery of targets. The stereo imagery was calibrated with a plexiglass cube having equal sides of 30 cm. The cameras have a low light (0.001 lux) auto adjusting iris with a 97^0 horizontal and 77^0 vertical view field. Two DSP&L Multi-SeaLites provided illumination that were dimmed remotely using a 120 v voltage regulator. The SeaLites were fitted with stainless collars which allowed for easy installation of various light filters in an effort to minimize avoidance reaction of organisms. The real-time depth profile, temperature, compass bearing, and three-dimensional orientation of the camera system were recorded every 10 seconds using the JASCO Attitude Sensor. Real-time dual video and environmental data were recorded from the MUVS through a 300 m multi-conductor cable to a PC computer and digital video recorders. Stereo recordings were synchronized using a Horita time-code generator.

Fisheries Scientific Computer System (FSCS):

The FRV Delaware's Scientific Computer System (SCS) was recently upgraded with the newly developed Fisheries Scientific Computer System (FSCS). The SCS system continuously collected navigational, oceanographic, and meteorological data, while the FSCS provided onboard entry of trawl station and catch data. Further improvements were also made to the SCS Event Logger program which provided an effective system for logging and managing operational events throughout the cruise. For example, all start and end data for deployments and acoustical transects were logged using the SCS Eventlog. The Eventlog also contained operational and observational comments. The Eventlog was critical for managing and linking our continuous and deployment type data by time. All computers, instrumentation, acoustic data collection, and data recording were synchronized in GMT time using the SCS master clock.

CTD Deployments:

Conductivity-Temperature-Depth (CTD) casts were conducted at the waypoints of each transect and before each deployment. CTD were deployed while drifting to obtain vertical hydrographic profile data from surface to bottom. Water bottle samples were typically taken once a day for salinity calibrations.

Survey Design Experiment:

Three type of surveys (*i.e.*, evenly spaced parallel, randomly spaced parallel, and zig-zag transects) were completed on Georges Bank to investigation the effects of survey designs on the variability of the acoustic populations estimates. An adaptive approach was implemented to ensure that the length of the transects included the herring aggregation (i.e., a transect did not end in an area of high fish concentration). Transects (lengths and distances between transects) were chosen to cover the bathymetric features (generally between 50-300 m) which delineated each historic spawning area. Survey speed was designated at 10 knots, while actual survey speeds ranged from 8-11 knots depending on weather conditions and currents.

In-situ TS Measurements:

Given the extensive cruise track, some of the preselected transects had to be dropped, and minimal time was allocated for collecting *in-situ* target strength (TS) measurements for herring.

Other Data: Conductivity-temperature-depth (CTD) were conducted throughout the cruise, generally at the transect nodes and locations of gear deployment. During part II of the cruise, Gerald Denny of Scientific Fisheries Incorporated (Anchorage, Alaska), conducted acoustic measurements with a broadband acoustic system. His towbody was suspended from the forward A-frame while the FR/V Delaware was drifting and during trawl operations. Acoustic data from the broadband system was collected and analyzed using a Scientific Fisheries software package. Also during part II, Dr. Redwood Nero and Mr. Charles Thompson of the Naval Research Laboratory, Stennis Space Center (Stennis, Mississippi) conducted acoustic measurements with a low-frequency broadband system. Two deployment methods were used. The first method was to deploy a raft and hydrophone array off the stern, and to collect data while the ship steamed at 2-4 knots along a transect. The second deployment method was to suspend an omni-directional transducer and hydrophone off the forward A-frame and collect data while drifting. The transducer and hydrophone were set at a variety of depths.

RESULTS

During the first day (4 September), the FRV Delaware's EK500 split-beam transducers (38 and 120 kHz) were successfully calibrated alongside the Woods Hole pier. The FRV Delaware departed on 5 September and completed systematic surveys on selected offshore banks in the Gulf of Maine (Jeffery's Ledge, Platts Bank, Cashes Ledge, and Fippennies Ledge) during 6-14 September (Figure 1). The single-beam 12 kHz transducer was calibrated in the Gulf of Maine during 7 September. An overnight portcall in Portland, Maine was made during 8-9 September to exchange scientific staff. The last few days of the first leg (9-14 September) was devoted to experimental work on using the EK500, broadband acoustics, and low-frequency acoustics. During part II, Atlantic herring aggregations were surveyed on Georges Bank using the two broadband acoustic systems (SciFish, Inc. and NRL) and the EK500. The systems were operated simultaneously during four deployments to collect data over a wide frequency spectrum (0.5-10 kHz, 12, 38 and 120 kHz, and 100-200 kHz). Data from these experiments are currently being analyzed.

During the second leg, the northern Georges Bank region was survey twice using an evenly spaced parallel transect design on 18-22 September and randomly selected parallel transect design on 23-27 September (Figures 2 and 3). For the third leg, a zig-zag survey design was completed on northern Georges Bank during 2-8 October. Given the extensive cruise track, some of the preselected transects were not completed and the number of trawl deployments was limited. Atlantic herring was the predominant pelagic species observed and captured during the surveys.

The remaining four days (9-12 October) of the cruise was dedicated to inter-vessel comparisons between the FRV Delaware's EK500 and Canadian RV Alfred Needler's SM2000 multibeam system.

In-situ TS measurements and video observations were made on spawning aggregations of herring on 11 October. Preliminary field tests using blue, green, red, and infrared light filters suggested that green filters might reduce avoidance reactions and provide adequate light penetration unlike the infrared light. Video observations were obtained during the spawning event, which was verified by the deposition of herring eggs on the MUVS camera array.

DISPOSITION OF DATA

All data and results are archived at the Northeast Fisheries Science Center. Results will be presented and data distribution on CD-ROM at an annual Northwest Atlantic Herring Acoustic Workshop in conjunction with scientists from the Canadian Department of Fisheries and Oceans.

SCIENTIFIC PERSONNEL

National Marine Fisheries Service, NEFSC, Woods Hole, MA		
William Michaels	Chief Scientist	Parts III, IV
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Woody Nero	Acoustical Engineer	Parts I, II
Charles Thompson	Acoustical Engineer	Parts I, II
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Julie Cequera	Student Volunteer	Parts I, II
David Chevier	Student Volunteer	Part IV

Part I	September 4-8, 2001
Part II	September 9-14, 2001
Part III	September 17-28, 2001
Part IV	October 1-12, 2001

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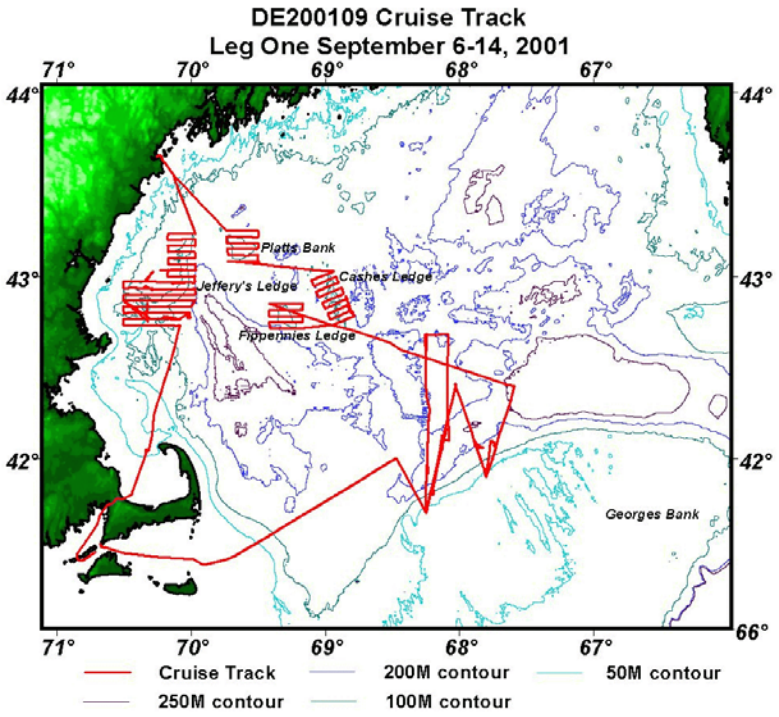

Figure 1. Cruise track for Part I of the Fall 2001 Atlantic Herring Hydroacoustic Survey cruise DE 01-09 during 6 - 14 September 2001. Systematic surveys were conducted on selected offshore banks in the Gulf of Maine and experimental operations were conducted along northern Georges Bank.

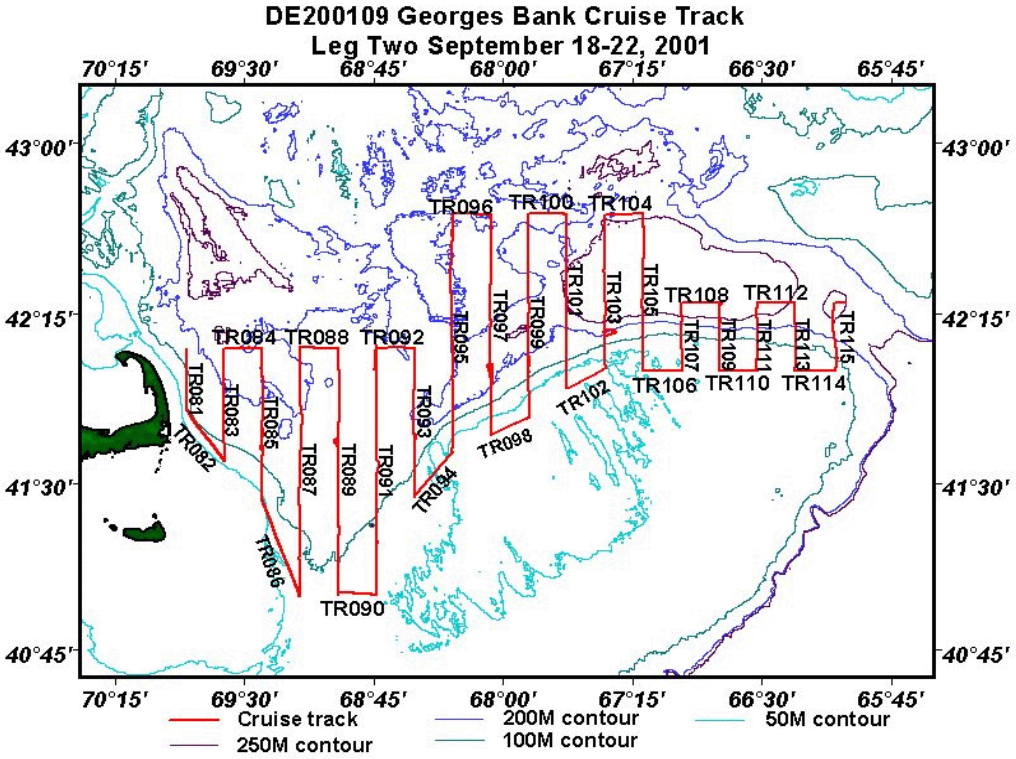

Figure 2. Systematic parallel transect survey for Part II of the Fall 2001 Atlantic Herring Hydroacoustic Survey cruise DE 01-09 during 18-22 September 2001.

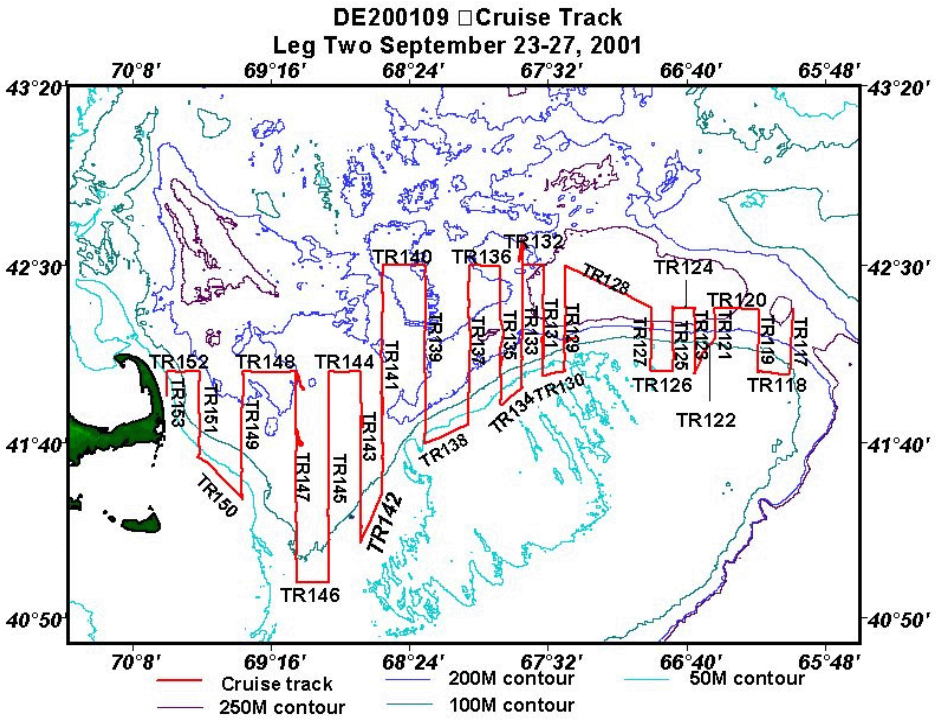

Figure 3. Random parallel transect survey for Part II of the Fall 2001 Atlantic Herring Hydroacoustic Survey cruise DE 01-09 during 23 - 27 September 2001.

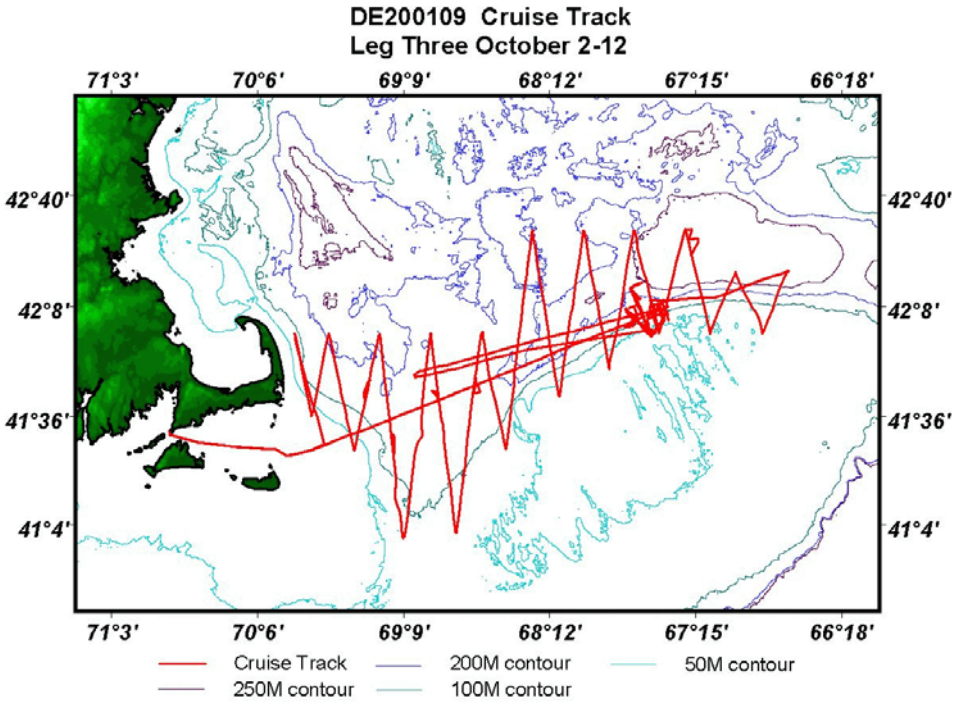

Figure 4. Cruise track for Part III of the Fall 2001 Atlantic Herring Hydroacoustic Survey cruise DE 01-09 during 2 - 12 October 2001. Zig-zag survey was conducted along northern Georges Bank. The FRV Delaware II conducted acoustic comparisons with the Canadian FRV Alfred Needler's SM2000 multibeam operations 7 - 11 October 2001.

Table 1. Deployment table for the Fall 2001 Atlantic Herring Hydroacoustic Survey

Date	Time	Site	Series	Deploy	Gear	Latitude	Longitude	EKLog	Comment
06/09/01	07:33:31	jfryl	prlll01	1	CTD	4243.800	7004.790	68.955	Start CTD #1
06/09/01	09:48:12	jfryl	prlll01	2	CTD	4244.020	7030.020	88.405	Start CTD #2
06/09/01	10:14:43	jfryl	prlll01	3	CTD	4245.960	7030.120	90.650	begin ctd cast #3
06/09/01	12:17:47	jfryl	prlll01	4	CTD	4246.040	7004.880	109.675	start ctd cast #4
06/09/01	13:57:05	jfryl	prlll01	5	HSMRT	4246.130	7010.260	113.955	test hsmrt trawl #5
06/09/01	15:20:51	jfryl	prlll01	6	CTD	4248.170	7000.650	125.255	begin ctd cast #005
06/09/01	17:26:14	jfryl	prlll01	7	NEROFQ	4247.750	7000.590	129.790	Nero and Thompson low-f testing
06/09/01	20:01:42	jfryl	prlll01	8	CTD	4247.930	7029.930	152.015	begin CTD #6 and water bottle #1
06/09/01	20:30:20	jfryl	prlll01	9	CTD	4250.030	7029.990	154.180	begin CTD #7
06/09/01	22:46:30	jfryl	prlll01	10	CTD	4249.970	6959.910	176.660	begin CTD #8
06/09/01	23:23:54	jfryl	prlll01	11	CTD	4252.030	6958.160	179.945	begin CTD cast #009
07/09/01	02:03:34	jfryl	prlll01	12	CTD	4251.910	7029.920	203.820	begin CTD cast #010
07/09/01	04:19:46	jfryl	prlll01	13	HSMRT	4248.400	7019.620	222.110	begin trawl #013 in Jeffreys Cove
07/09/01	06:25:59	jfryl	prlll01	14	CTD	4254.020	7029.930	237.915	begin ctd deployment #11
07/09/01	08:50:54	jfryl	prlll01	15	CTD	4253.980	6958.200	261.250	begin ctd deployment #12
07/09/01	09:26:02	jfryl	prlll01	16	CTD	4255.970	6958.270	263.515	begin ctd deployment #13
07/09/01	11:23:47	jfryl	prlll01	17	CTD	4255.940	7021.150	280.700	start ctd cast #14
07/09/01	11:55:55	jfryl	prlll01	18	HSMRT	4255.980	7019.100	282.245	start HSMRT #18
07/09/01	14:01:35	jfryl	prlll01	19	CTD	4255.990	7030.110	294.700	begin ctd cast # 015
07/09/01	14:24:21	jfryl	prlll01	20	CTD	4258.100	7030.200	296.920	begin ctd cast # 016
08/09/01	00:04:47	jfryl	prlll01	21	HSMRT	4258.070	7004.160	324.495	begin trawl #21
08/09/01	02:00:31	jfryl	prlll01	22	CTD	4258.070	6958.190	335.530	begin cast #017 depl 022
08/09/01	02:34:48	jfryl	prlll01	23	CTD	4300.030	6958.150	337.600	begin ctd cast #18
08/09/01	03:39:24	jfryl	prlll01	24	CTD	4300.040	7010.290	346.720	begin ctd cast #19
08/09/01	04:10:27	jfryl	prlll01	25	CTD	4302.000	7010.150	348.765	start ctd cast #20
08/09/01	05:06:59	jfryl	prlll01	26	CTD	4302.120	7002.170	354.995	begin CTD cast #21
08/09/01	06:02:53	jfryl	prlll01	27	HSMRT	4302.230	7007.940	359.470	HSMRT #027
08/09/01	08:19:03	jfryl	prlll01	28	CTD	4302.010	6958.060	375.075	begin ctd cast #22
08/09/01	08:52:48	jfryl	prlll01	29	CTD	4303.910	6958.230	377.190	begin ctd cast #23
08/09/01	10:08:46	jfryl	prlll01	30	CTD	4303.970	7010.130	386.510	begin ctd cast #24
08/09/01	10:36:34	jfryl	prlll01	31	CTD	4305.960	7010.010	388.680	begin ctd cast #25
08/09/01	11:44:09	jfryl	prlll01	32	CTD	4306.100	6958.080	397.650	begin ctd cast #26

Date	Time	Site	Series	Deploy	Gear	Latitude	Longitude	EKLog	Comment
08/09/01	12:10:55	jfryl	prlll01	33	CTD	4308.100	6958.290	399.875	begin ctd cast #27
08/09/01	13:22:08	jfryl	prlll01	34	CTD	4307.960	7010.050	409.075	begin ctd cast #28
08/09/01	13:50:36	jfryl	prlll01	35	CTD	4310.030	7010.320	411.580	start ctd cast #29
08/09/01	14:51:32	jfryl	prlll01	36	CTD	4309.920	6958.170	420.610	begin ctd cast #30
08/09/01	15:15:06	jfryl	prlll01	37	CTD	4312.110	6958.260	422.955	begin ctd cast #31
08/09/01	16:19:44	jfryl	prlll01	38	CTD	4312.010	7010.390	432.155	begin CTD cast #32
08/09/01	16:44:19	jfryl	prlll01	39	CTD	4314.040	7010.230	434.265	begin CTD cast #33
08/09/01	17:50:53	jfryl	prlll01	40	CTD	4313.950	6958.120	443.330	begin CTD cast #34
09/09/01	19:28:38	plttb	prlll02	41	CTD	4315.030	6944.030	478.325	begin CTD cast #35
09/09/01	20:41:53	plttb	prlll02	42	CTD	4315.040	6930.070	488.620	begin CTD cast #36
10/09/01	01:49:24	plttb	prlll02	43	CTD	4304.980	6929.850	539.795	begin CTD cast #37
10/09/01	03:20:10	plttb	prlll02	44	CTD	4304.970	6943.770	550.765	begin CTD cast #38
10/09/01	06:42:14	cshsl	prlll03	45	CTD	4301.680	6856.300	584.585	begin CTD cast #39
10/09/01	07:46:21	cshsl	prlll03	46	CTD	4258.590	6906.280	592.855	begin CTD cast #40
10/09/01	13:27:31	cshsl	prlll03	47	BRDBND	4249.870	6849.240	643.755	Skip's broadband #1deployment 47
10/09/01	14:10:02	cshsl	prlll03	48	HSMRT	4250.490	6849.450	646.945	Begin HSMRT #048 w/ broadband
10/09/01	16:35:27	cshsl	prlll03	49	NEROFQ	4249.530	6849.090	654.875	begin low-frequency Nero/Thompson
10/09/01	19:35:31	cshsl	prlll03	50	CTD	4247.000	6846.980	679.305	begin CTD cast #41 & water bottle
10/09/01	20:42:26	cshsl	prlll03	51	CTD	4244.030	6856.520	687.385	begin CTD cast #42
10/09/01	21:59:29	fpnsl	prlll04	52	CTD	4242.970	6909.940	697.705	begin CTD cast #43
10/09/01	23:22:25	fpnsl	prlll04	53	CTD	4242.940	6924.870	708.985	begin CTD cast #44
11/09/01	03:32:23	fpnsl	prlll04	54	CTD	4250.980	6909.880	750.405	begin CTD cast #45
11/09/01	05:00:40	fpnsl	prlll04	55	CTD	4251.010	6925.020	761.560	begin CTD cast #46
11/09/01	12:59:12	grgsb	zigzg01	56	CTD	4224.030	6735.790	847.055	begin CTD cast #47
11/09/01	16:14:22	grgsb	zigzg01	57	CTD	4153.960	6747.950	878.785	begin CTD cast #48
11/09/01	16:59:34	grgsb	zigzg01	58	BRDBND	4159.350	6745.370	884.725	start Scifish broadband
11/09/01	17:23:00	grgsb	zigzg01	59	HSMRT	4200.900	6744.800	886.300	Start HSMRT #59
11/09/01	18:58:00	grgsb	zigzg01	60	NEROFQ	4205.460	6744.990	891.600	Start NEROFQ deployment #60
11/09/01	22:17:13	grgsb	zigzg01	61	HSMRT	4205.240	6753.160	918.955	midwater trawl on herring scatter
11/09/01	23:59:51	grgsb	zigzg01	62	HSMRT	4204.480	6752.190	927.220	begin midwater trawl on herring
12/09/01	01:32:48	grgsb	zigzg01	63	BRDBND	4203.390	6752.210	933.840	Scifish broadband
12/09/01	01:33:23	grgsb	zigzg01	64	NEROFQ	4203.370	6752.200	933.860	Begin NEROFQ
12/09/01	12:08:59	grgsb	zigzg01	65	CTD	4142.010	6814.810	1009.200	begin ctd cast 049
12/09/01	13:56:14	grgsb	zigzg01	66	HSMRT	4152.420	6811.620	1022.090	start midwater trawling

Date	Time	Site	Series	Deploy	Gear	Latitude	Longitude	EKLog	Comment
12/09/01	17:57:08	grgsb	zigzg01	67	CTD	4209.840	6805.960	1049.730	start CTD cast #50
12/09/01	18:17:23	grgsb	zigzg01	68	BRDBND	4209.590	6805.830	1050.135	Start Skip Denny broadband #068
12/09/01	18:43:11	grgsb	zigzg01	69	HSMRT	4208.090	6806.440	1051.710	Start HSMRT #069
12/09/01	20:15:18	grgsb	zigzg01	70	NEROFQ	4202.920	6807.650	1057.060	start Deployment #070 Nerofq
12/09/01	22:53:46	grgsb	zigzg01	71	BRDBND	4209.760	6806.090	1065.085	skips broadband w/ trawling
12/09/01	23:28:45	grgsb	zigzg01	72	HSMRT	4207.310	6806.870	1067.610	Begin HSMRT #072
13/09/01	01:22:53	grgsb	zigzg01	73	NEROFQ	4207.110	6807.840	1075.695	low frequency acoustic Nero
13/09/01	03:21:50	grgsb	zigzg01	74	NEROFQ	4206.120	6806.790	1077.645	drifting xducer/hydrophone
13/09/01	09:31:53	grgsb	zigzg01	75	CTD	4241.010	6805.120	1115.315	start CTD cast #051 w/ bottle #4
13/09/01	10:31:56	grgsb	zigzg01	76	CTD	4240.880	6814.870	1122.770	begin CTD cast #052
13/09/01	11:29:03	grgsb	zigzg01	77	HSMRT	4236.560	6814.800	1129.270	begin trawl
13/09/01	17:07:02	grgsb	zigzg01	78	CTD	4154.810	6814.300	1180.570	start CTD cast #053
13/09/01	17:32:03	grgsb	zigzg01	79	BRDBND	4155.000	6813.900	1181.100	Start Skip Denny deployment #079
13/09/01	17:57:00	grgsb	zigzg01	80	HSMRT	4156.600	6813.900	1182.700	Start HSMRT #080 - aborted - FS903
13/09/01	21:52:08	grgsb	zigzg01	81	CTD	4159.920	6828.140	1220.120	start CTD cast #54
18/09/01	02:54:14	grgsb	prlll05	82	CTD	4206.060	6949.910	1304.915	start CTD cast #055
18/09/01	04:33:26	grgsb	prlll05	83	CTD	4149.930	6950.140	1320.870	start CTD cast #056
18/09/01	06:17:46	grgsb	prlll05	84	CTD	4135.840	6936.890	1337.735	start CTD cast #057
18/09/01	09:30:48	grgsb	prlll05	85	CTD	4206.010	6937.040	1368.310	start CTD cast #058
18/09/01	10:46:19	grgsb	prlll05	86	CTD	4206.020	6923.780	1378.440	start CTD cast #059
18/09/01	13:53:41	grgsb	prlll05	87	CTD	4138.980	6923.990	1406.105	start CTD cast #060
18/09/01	14:46:11	grgsb	prlll05	88	HSMRT	4141.420	6923.810	1408.740	start 1st trawl of 2nd leg
18/09/01	18:07:51	grgsb	prlll05	89	CTD	4125.570	6923.660	1435.185	start CTD cast #061
18/09/01	20:27:57	grgsb	prlll05	90	CTD	4059.850	6910.600	1462.790	start CTD cast #062
19/09/01	03:11:51	grgsb	prlll05	91	CTD	4206.130	6910.680	1529.930	start CTD cast #063
19/09/01	04:27:40	grgsb	prlll05	92	CTD	4206.040	6857.220	1540.240	start CTD Cast # 064
19/09/01	07:14:22	grgsb	prlll05	93	CTD	4138.980	6857.110	1567.695	start CTD Cast # 065
19/09/01	07:44:42	grgsb	prlll05	94	HSMRT	4139.360	6857.140	1568.795	start trawl #093
19/09/01	13:06:26	grgsb	prlll05	95	CTD	4100.180	6857.150	1614.820	start ctd cast 66
19/09/01	14:24:36	grgsb	prlll05	96	CTD	4100.130	6843.760	1625.625	start ctd cast 67 w/ water bottle
19/09/01	16:01:15	grgsb	prlll05	97	CTD	4118.610	6843.770	1644.150	start ctd cast #068
19/09/01	16:31:50	grgsb	prlll05	98	HSMRT	4117.750	6843.770	1645.520	begin midwater trawl
19/09/01	22:47:50	grgsb	prlll05	99	CTD	4205.920	6843.820	1702.280	start ctd cast 069
19/09/01	23:25:25	grgsb	prlll05	100	HSMRT	4205.730	6843.810	1704.890	HSMRT in
20/09/01	02:38:57	grgsb	prlll05	101	CTD	4206.090	6830.690	1726.570	Start CTD #70

Date	Time	Site	Series	Deploy	Gear	Latitude	Longitude	EKLog	Comment
20/09/01	05:38:12	grgsb	prlll05	102	CTD	4139.770	6830.570	1753.515	Start CTD #71
20/09/01	06:56:48	grgsb	prlll05	103	HSMRT	4143.110	6830.590	1757.475	Start HRMRT #103
20/09/01	09:10:48	grgsb	prlll05	104	CTD	4126.350	6830.710	1774.300	start CTD cast #072
20/09/01	11:01:47	grgsb	prlll05	105	CTD	4138.380	6817.400	1789.805	Start CTD cast #073
20/09/01	17:00:01	grgsb	prlll05	106	CTD	4241.520	6817.280	1829.635	start CTD cast #074
20/09/01	17:42:02	grgsb	prlll05	107	HSMRT	4240.140	6817.240	1831.505	start midwater trawl #107
20/09/01	20:37:16	grgsb	prlll05	108	CTD	4241.470	6804.170	1850.985	start CTD cast # 075
21/09/01	01:08:42	grgsb	prlll05	109	CTD	4156.250	6803.690	1895.205	start CTD cast # 076
21/09/01	01:37:12	grgsb	prlll05	110	HSMRT	4157.560	6803.800	1896.590	Begin HSMRT #110
21/09/01	04:56:04	grgsb	prlll05	111	CTD	4142.830	6803.920	1920.640	start CTD cast #077
21/09/01	05:58:58	grgsb	prlll05	112	CTD	4147.560	6750.880	1931.315	start CTD cast #078
21/09/01	07:31:04	grgsb	prlll05	113	CTD	4202.650	6751.000	1945.555	start CTD cast #079
21/09/01	08:27:31	grgsb	prlll05	114	HSMRT	4200.020	6750.870	1950.840	begin HSMRT #114
21/09/01	13:16:24	grgsb	prlll05	115	CTD	4241.550	6750.910	1993.815	start CTD cast #080
21/09/01	14:26:33	grgsb	prlll05	116	CTD	4241.490	6737.720	2003.690	start CTD cast #081 & water bottle
21/09/01	19:22:18	grgsb	prlll05	117	CTD	4155.310	6737.630	2048.910	start CTD cast #082
21/09/01	20:28:53	grgsb	prlll05	118	CTD	4200.580	6724.250	2059.440	start CTD cast #083
21/09/01	21:39:55	grgsb	prlll05	119	CTD	4210.690	6724.560	2069.430	start CTD cast #084
21/09/01	22:31:05	grgsb	prlll05	120	HSMRT	4209.780	6721.870	2073.690	start HSMRT at 200M wire out
22/09/01	02:13:35	grgsb	prlll05	121	CTD	4241.400	6724.280	2104.625	start CTD cast #085
22/09/01	03:25:08	grgsb	prlll05	122	CTD	4241.500	6711.070	2113.815	start CTD cast #086
22/09/01	07:51:27	grgsb	prlll05	123	CTD	4200.010	6710.980	2154.060	start CTD cast #087
22/09/01	08:50:19	grgsb	prlll05	124	CTD	4159.920	6657.640	2163.305	start CTD cast #088
22/09/01	10:53:14	grgsb	prlll05	125	CTD	4218.050	6657.610	2181.885	start CTD cast #089
22/09/01	12:03:46	grgsb	prlll05	126	CTD	4217.880	6644.170	2191.930	start CTD cast #090
22/09/01	14:01:49	grgsb	prlll05	127	CTD	4159.940	6644.690	2210.485	start CTD cast #091 & water bottle
22/09/01	15:17:40	grgsb	prlll05	128	CTD	4200.070	6631.490	2220.725	start CTD cast #092
22/09/01	17:04:17	grgsb	prlll05	129	CTD	4218.010	6631.460	2238.725	start CTD cast #093
22/09/01	18:19:53	grgsb	prlll05	130	CTD	4217.990	6618.290	2248.920	start CTD cast #094
22/09/01	20:25:07	grgsb	prlll05	131	CTD	4200.050	6618.000	2267.250	start CTD cast #095
22/09/01	21:20:28	grgsb	prlll05	132	CTD	4159.870	6604.540	2277.360	start CTD cast #096
22/09/01	23:25:18	grgsb	prlll05	133	CTD	4218.140	6604.610	2296.115	start CTD cast #097
22/09/01	23:57:20	grgsb	rndpl01	134	CTD	4218.020	6600.410	2299.270	start CTD cast #098
23/09/01	01:49:24	grgsb	rndpl01	135	CTD	4159.840	6600.660	2311.950	start CTD cast #099
23/09/01	02:50:06	grgsb	rndpl01	136	CTD	4159.920	6612.890	2313.030	start CTD cast #100
23/09/01	04:42:52	grgsb	rndpl01	137	CTD	4217.910	6612.720	2316.780	start CTD cast #101
23/09/01	06:06:39	grgsb	rndpl01	138	CTD	4217.960	6629.050	2318.140	start CTD cast #102
23/09/01	08:14:10	grgsb	rndpl01	139	CTD	4200.070	6628.870	2322.855	start CTD cast #103
23/09/01	09:06:47	grgsb	rndpl01	140	CTD	4200.010	6636.920	2322.940	start CTD cast #104
23/09/01	13:52:07	grgsb	rndpl01	141	CTD	4217.880	6636.960	2368.575	start CTD cast #105

Date	Time	Site	Series	Deploy	Gear	Latitude	Longitude	EKLog	Comment
23/09/01	14:48:13	grgsb	rndpl01	142	CTD	4217.880	6645.040	2375.265	start CTD cast #106
23/09/01	17:35:43	grgsb	rndpl01	143	CTD	4200.100	6645.180	2390.885	start CTD cast #107
23/09/01	18:14:27	grgsb	rndpl01	144	CTD	4200.130	6653.110	2396.615	start CTD cast #108
23/09/01	20:00:00	grgsb	rndpl01	145	HSMRT	4209.400	6652.900	2413.100	Start HSMRT #145
23/09/01	22:02:44	grgsb	rndpl01	146	CTD	4218.050	6653.190	2425.445	Start CTD deployment 146 cast 109
24/09/01	00:58:07	grgsb	rndpl01	147	CTD	4229.850	6725.590	2452.290	start CTD cast 110
24/09/01	03:13:53	grgsb	rndpl01	148	CTD	4208.090	6725.660	2473.450	start CTD cast 111
24/09/01	04:03:30	grgsb	rndpl01	149	HSMRT	4209.180	6723.070	2478.110	HSMRT in
24/09/01	05:34:49	grgsb	rndpl01	150	CTD	4200.160	6725.580	2488.725	start CTD cast #112
24/09/01	06:20:26	grgsb	rndpl01	151	CTD	4158.780	6733.650	2495.170	start CTD cast #113
24/09/01	07:12:45	grgsb	rndpl01	152	HSMRT	4206.100	6733.650	2501.905	start midwater trawl
24/09/01	11:04:58	grgsb	rndpl01	153	CTD	4230.020	6733.550	2536.755	start CTD cast #114
24/09/01	11:57:04	grgsb	rndpl01	154	CTD	4229.910	6741.450	2542.860	start CTD cast #115
24/09/01	12:57:30	grgsb	rndpl01	155	CTD	4237.280	6741.240	2550.455	start CTD cast #116
24/09/01	13:38:29	grgsb	rndpl01	156	HSMRT	4234.580	6741.070	2553.090	begin HSMRT #156
24/09/01	19:21:23	grgsb	rndpl01	157	CTD	4155.390	6741.550	2605.240	start CTD cast #117
24/09/01	20:17:08	grgsb	rndpl01	158	CTD	4150.400	6749.560	2613.270	start CTD cast #118
24/09/01	21:24:23	grgsb	rndpl01	159	CTD	4201.750	6749.700	2624.565	start CTD cast #119
24/09/01	22:06:07	grgsb	rndpl01	160	HSMRT	4200.940	6749.710	2628.290	start midwater trawl #160
25/09/01	18:08:00	grgsb	rndpl01	161	CTD	4148.060	6833.930	2832.890	start CTD cast # 120
25/09/01	18:40:06	grgsb	rndpl01	162	HSMRT	4149.310	6834.060	2834.160	midwater trawl in the water #162
26/09/01	01:14:26	grgsb	rndpl01	163	CTD	4120.350	6842.170	2892.305	start CTD cast #121
26/09/01	01:38:29	grgsb	rndpl01	164	HSMRT	4119.160	6841.990	2893.540	HSMRT #164 IN
26/09/01	05:29:31	grgsb	rndpl01	165	CTD	4147.710	6841.930	2928.860	start CTD cast #122
26/09/01	05:59:39	grgsb	rndpl01	166	HSMRT	4146.870	6841.860	2929.905	HSMRT doors in the water #166
26/09/01	19:51:30	grgsb	rndpl01	167	CTD	4143.820	6906.270	3069.685	Start CTD cast #123
26/09/01	20:24:00	grgsb	rndpl01	168	HSMRT	4142.510	6905.720	3071.220	Start HSMRT trawl doors #168
26/09/01	23:38:40	grgsb	rndpl01	169	CTD	4159.960	6906.410	3097.170	start CTD cast #124
27/09/01	00:08:08	grgsb	rndpl01	170	HSMRT	4159.000	6905.740	3098.350	HSMRT #170 IN
03/10/01	03:42:32	grgsb	zigzg02	171	CTD	4159.930	6951.440	3273.915	CTD cast #125
03/10/01	05:59:06	grgsb	zigzg02	172	CTD	4136.060	6944.970	3298.210	begin CTD cast #126
03/10/01	08:32:44	grgsb	zigzg02	173	CTD	4159.980	6938.290	3322.970	CTD cast #127
03/10/01	12:06:58	grgsb	zigzg02	174	CTD	4125.840	6928.140	3357.900	begin CTD cast #128
03/10/01	13:45:49	grgsb	zigzg02	175	CTD	4143.310	6923.060	3375.080	begin CTD cast #129
03/10/01	15:00:41	grgsb	zigzg02	176	HSMRT	4146.350	6922.220	3379.020	Begin HSMRT #176
03/10/01	18:47:02	grgsb	zigzg02	177	CTD	4159.960	6918.410	3404.890	begin CTD #177 cast 130
03/10/01	22:09:17	grgsb	zigzg02	178	CTD	4124.690	6912.960	3440.430	CTD cast #131
03/10/01	22:38:27	grgsb	zigzg02	179	HSMRT	4125.570	6912.990	3441.615	Midwater trawl doors in the water

Date	Time	Site	Series	Deploy	Gear	Latitude	Longitude	EKLog	Comment
04/10/01	03:22:16	grgsb	zigzg02	180	CTD	4100.110	6909.080	3477.755	CTD cast #132
04/10/01	09:15:52	grgsb	zigzg02	181	CTD	4200.060	6858.270	3538.825	CTD cast #133
04/10/01	11:15:39	grgsb	zigzg02	182	CTD	4140.590	6855.370	3558.500	Begin CTD cast #134
04/10/01	11:42:15	grgsb	zigzg02	183	HSMRT	4141.680	6855.790	3559.770	begin HSMRT #183
04/10/01	17:42:26	grgsb	zigzg02	184	CTD	4101.580	6848.570	3605.720	begin CTD cast #135
04/10/01	22:10:34	grgsb	zigzg02	185	CTD	4147.490	6841.080	3651.990	CTD cast #136
04/10/01	22:55:05	grgsb	zigzg02	186	HSMRT	4146.470	6840.690	3653.185	Begin Midwater trawl 186
05/10/01	02:07:53	grgsb	zigzg02	187	CTD	4200.070	6838.560	3676.355	CTD cast #137
05/10/01	06:21:01	grgsb	zigzg02	188	CTD	4126.460	6829.030	3712.000	CTD cast #138
05/10/01	12:20:15	grgsb	zigzg02	189	CTD	4230.050	6818.640	3775.785	start CTD cast #139
05/10/01	17:31:53	grgsb	zigzg02	190	CTD	4141.680	6808.210	3825.055	start CTD cast #140 w/ water cast
05/10/01	22:15:31	grgsb	zigzg02	191	CTD	4229.970	6758.850	3874.165	CTD cast #141
06/10/01	02:33:11	grgsb	zigzg02	192	CTD	4149.850	6748.720	3915.155	CTD cast #142
06/10/01	06:28:57	grgsb	zigzg02	193	CTD	4230.020	6739.030	3955.225	CTD cast #143
06/10/01	11:41:52	grgsb	zigzg02	194	CTD	4203.680	6730.320	3982.480	start CTD cast #144
06/10/01	12:08:34	grgsb	zigzg02	195	HSMRT	4205.390	6730.790	3984.315	HSMRT IN
06/10/01	14:44:30	grgsb	zigzg02	196	CTD	4200.180	6729.130	3995.995	Start CTD cast #145
06/10/01	18:11:48	grgsb	zigzg02	197	CTD	4230.080	6719.030	4026.920	begin CTD cast #146
07/10/01	02:52:50	grgsb	zigzg02	198	CTD	4200.010	6709.240	4077.945	CTD cast #147
07/10/01	04:52:13	grgsb	zigzg02	199	CTD	4217.920	6659.240	4096.940	CTD cast #148
07/10/01	07:04:42	grgsb	zigzg02	200	CTD	4200.200	6648.790	4115.530	CTD cast #149
07/10/01	09:06:54	grgsb	zigzg02	201	CTD	4218.300	6638.840	4134.745	CTD cast #150
09/10/01	15:21:41	grgsb	prlll07	202	VIDEO	4205.520	6740.900	4316.315	start underwater video deployment
09/10/01	18:34:11	grgsb	prlll07	203	VIDEO	4204.610	6738.390	4318.410	start underwater video deployment
09/10/01	19:32:37	grgsb	prlll07	204	VIDEO	4206.230	6741.700	4322.080	start video - blue filter used
09/10/01	20:16:36	grgsb	prlll07	205	VIDEO	4205.900	6741.420	4322.480	start video - red filter used
09/10/01	20:46:13	grgsb	prlll07	206	VIDEO	4205.710	6741.100	4322.770	start video - infrared filter used
09/10/01	21:16:29	grgsb	prlll07	207	VIDEO	4205.530	6740.660	4323.105	start video - green filter used
09/10/01	22:22:18	grgsb	prlll07	208	CTD	4204.780	6738.280	4325.025	begin ctd cast #151
09/10/01	23:24:20	grgsb	prlll07	209	HSMRT	4205.270	6739.790	4326.985	doors in the water
10/10/01	02:14:02	grgsb	prlll07	210	HSMRT	4202.520	6740.970	4340.095	doors in the water
10/10/01	07:20:41	grgsb	prlll07	211	VIDEO	4159.940	6732.450	4368.130	video on spawning herring on bank
10/10/01	07:59:31	grgsb	prlll07	212	VIDEO	4159.690	6732.940	4369.765	begin video on herring
10/10/01	08:45:05	grgsb	prlll07	213	VIDEO	4159.530	6732.910	4371.565	video on herring - no light filter
10/10/01	09:31:12	grgsb	prlll07	214	VIDEO	4159.690	6732.780	4373.015	video on herring - red filter
10/10/01	10:30:47	grgsb	prlll07	215	VIDEO	4159.980	6732.860	4375.145	start video - herring green filter
10/10/01	11:17:36	grgsb	prlll07	216	VIDEO	4159.940	6732.860	4377.070	begin video - herring green filter

Date	Time	Site	Series	Deploy	Gear	Latitude	Longitude	EKLog	Comment
10/10/01	13:07:42	grgsb	prlll07	217	VIDEO	4205.420	6735.130	4389.795	begin video - herring green filter
10/10/01	13:49:49	grgsb	prlll07	218	VIDEO	4205.580	6733.760	4390.620	begin video calibration
10/10/01	14:41:47	grgsb	prlll07	219	HSMRT	4205.470	6734.310	4391.845	Start HSMRT test trawl
10/10/01	17:46:26	grgsb	prlll07	220	CTD	4206.330	6726.250	4403.980	start CTD cast#152 w/ water bottle
10/10/01	19:45:11	grgsb	prlll07	221	VIDEO	4159.650	6732.640	4413.915	begin video - green light filter
11/10/01	06:10:12	grgsb	prlll07	222	VIDEO	4159.500	6732.360	4455.400	begin video - green light filter
11/10/01	06:55:21	grgsb	prlll07	223	VIDEO	4159.850	6732.660	4457.390	begin video - green light filter
11/10/01	08:06:46	grgsb	prlll07	224	VIDEO	4159.730	6732.680	4462.065	begin video - green filter lateral
11/10/01	08:43:36	grgsb	prlll07	225	VIDEO	4159.630	6732.860	4463.610	begin video -green filter -lateral
11/10/01	12:45:46	grgsb	prlll07	226	VIDEO	4209.490	6738.160	4484.540	start video - green light filter
11/10/01	18:09:11	grgsb	prlll07	227	VIDEO	4204.700	6735.120	4512.100	begin video - green light filter